

EXPLANATION OF PLATES XIX AND XX.

(All figures on Plate XIX are magnified 450 diameters; all on Plate XX 600 diameters).

Figs. 1, 2 and 3, receptacle of the flower axis, with individual florets appearing in Figs. 2 and 3*a*. Fig. 4, a single floret before the appearance of flower parts. Fig. 5*a*, the first floral whorl, the corolla. Fig. 6, further development of corolla. Fig. 7, the corolla, the appearance of the andrœcium *a* and the calyx *b*. Fig. 8, a later stage of fig. 7. Fig. 9*a*, the formation of the ovary; *b*, the bracteole. Fig. 10, a further development of fig. 9, showing the flask-shaped ovary *a*. Fig. 11, the formation of the ovule with all other parts eliminated. Fig. 12*a*, the nucellus of the ovule; *b*, appearance of the integument. Fig. 13, later development of fig. 12; *a*, the nucellus; *b*, the embryo-sac. Fig. 14, a further development of fig. 13. Fig. 15, the mother-cell divided once. Fig. 16, the cells divided again. Fig. 17*a*, the true mother-cell of the embryo-sac, the upper three cells becoming disorganized. Fig. 18, disappearance of the upper cells, the mother cell occupying a central position, the nucellus breaking up and showing signs of disappearance. Fig. 19, a further development of Fig. 18; the nucellus almost gone and the appearance of vacuoles. From fig. 20 to fig. 23, inclusive, are shown the division of the mother-cell and its further divisions, culminating in the formation of the egg-apparatus, the antipodal cells and the endosperm nucleus; the vacuoles and the expansion of the embryo-sac.

A study of some anatomical characters of North-American Gramineæ. IV.

THEO. HOLM.

The genus *Leersia*.

(WITH PLATE XXI.)

In previously published papers¹ the anatomical characters of *Uniola*, *Distichlis* and *Pleuropogon* have been discussed, and it is the purpose of this, and a following paper, to show how the species of *Leersia* may be distinguished anatomically.

It would, of course, have been more proper to proceed from *Uniola* to the genera allied to it. This was done when the comparison was drawn between *Uniola*, *Distichlis*, and *Pleuropogon*; but the lack of sufficient material has necessitated a change in the order of treatment. Some groups, at least, of closely related genera may be considered at once, so as to give a broader view of their anatomical divergencies.

¹Botanical Gazette, June, August and October, 1891.

Five species of *Leersia* are enumerated from this country, namely: *L. oryzoides* Swtz., *L. Virginica* Willd., *L. lenticularis* Michx., *L. monandra* Swtz. and *L. hexandra* Swtz.

LEERSIA ORYZOIDES Swtz. A series of anatomical sections has been figured on plate XX, and the rule has been followed strictly, as before, of taking the sections from the middle part of the blade of completely developed leaves. It must be noted, however, that such leaves only have been used for examination as are situated at the base of the culms or those belonging to the shoots of innovation.

The epidermis of the inferior face is very rough from several kinds of expansions, and represents two forms of cells: the proper epidermis cells and the bulliform cells. The first of these are rectangular, with thin undulate radial walls and strongly thickened exterior ones. Seen in transverse section (plate XX, fig. 9) they show a rather narrow lumen. These cells cover the entire face, excepting the two lines on the sides of the carene, where the bulliform cells are to be observed (figs. 7 and 8, at *BC.*). The different kinds of epidermal expansions, mentioned above, are straight or curved thorn-shaped expansions, warts and hairs. The first of these (fig. 3) are straight, pointed and very thick walled, and form several longitudinal lines outside of the mesophyll and among the bulliform cells. The curved ones, pointing downward, are also thick walled and very sharply pointed; their base is surrounded by four similarly thickened cells, distinctly porose (figs. 4, 5 and 6) these expansions are also numerous, arranged in lines outside the groups of stereome. The warts (fig. 1.) are roundish, obtuse and solid projections, of which about fifteen are present on each epidermis cell, excepting, where the curved, thorn shaped expansions are found. They are covered with a distinct cuticula like the other expansions. Hairs (fig. 2) are also present, consisting of three thin walled cells, the apical not pointed. They form a few longitudinal rows outside the mesophyll, but close to the stereome.

Stomata are present in largest number on this, the inferior, face of the blade; they form usually two rows on each side of the lines of stereome, and are situated close together in regular alternation with each other. The stomata themselves are in the same plane as the epidermis cells and are surrounded only by some of the wart-shaped expansions.

we compare the epidermis of the inferior with that of the superior face, there is but slight difference. The bulliform cells, occupying the largest part of the latter, form groups between all the mestome bundles; the stomata are less numerous, forming only one row on each side of the stereome.

The mestome bundles represent three degrees in this species, the difference depending upon the following characters: a thick-walled mestome sheath in connection with a layer of similarly thickened parenchyma, separating the leptome from the hadrome, both of which being well differentiated, are characteristic of those of the first degree (fig. 9). These, the largest bundles, including the midrib, are by no means so numerous as the small ones, representing the second degree. These last have a distinct, but thin walled mestome sheath inside the colorless parenchyma sheath, and have no layer of thick walled parenchyma between the leptome and the hadrome. The smallest bundles (fig. 10) contain only leptome but show the mestome sheath very distinctly. Besides these three forms of mestome-bundles, all of which lie in the same plane, there are from one (fig. 7) to three (fig. 8) very small ones which belong to the superior face of the carene. It is a marked characteristic of *Leersia* that the leaf possesses such small mestome bundles on the superior face. If there is only one, this is, as shown in figure 7, situated exactly above the large midrib; when three are present, the median one of these occupies that place, as shown in the figure 8. Moreover in the same figure the carene has two small bundles on the inferior face, one on each side of the large, median one, which makes this leaf have in all six nerves in the carene, while the other section (fig. 7) shows only two.

It is difficult to say whether this difference does or does not depend upon the locality. We can only state, that the specimen from which figure 7 was drawn, was collected near Washington, D. C., in a wet place, while the other (fig. 8) was taken from a specimen collected in Texas. Duval-Jouve¹ has figured a leaf of the same species, and his drawing agrees perfectly with figure 8, but he does not state whether his specimen was from Europe or from America.

By examining these small bundles from the superior face

¹Histotaxie des feuilles de Graminées. Annales d. Sc. Nat. Botanique, Series VI, vol. 1. (1875.) p. 294.

of the carene, it is seen (fig. 11) that some of them are not surrounded by any parenchyma or mestome sheath, and that the leptome is well developed, the hadrome, on the contrary, being less differentiated.

In regard to the parenchyma sheath, which surrounds all the other mestome bundles in the blade, it is seen, in transverse section, to be composed of roundish and thin-walled cells containing chlorophyll, except in the median bundle and in a few bundles next this. The sheath forms a closed ring in the mestome bundles of second and third degree, while in the largest ones it is interrupted above and below by the groups of stereome.

Mention has been made of the presence of a mestome-sheath in the bundles of the leaf of this species of *Leersia*. This fact has also been recorded by Schwendener² who enumerates the species of Gramineæ containing the sheath, as examined by him. It may here be mentioned that this author has observed the presence of this sheath in *Oryza sativa* and *Zizania aquatica* as well as in *Leersia oryzoides* of the group ORYZEAE. There is often, however, some difficulty in deciding whether such thick-walled sheaths are to be considered as mestome sheaths or not. In the case of *Uniola* (l. c.) it seems probable that there is no mestome sheath. But in regard to *Distichlis*, and the so-called *Uniola Palmeri*, which, as stated before (l. c.), ought not to be separated from *Distichlis*, these two plants seem to have true mestome sheaths. That this character was not attributed to them in the anatomical diagnosis lately given² was due to the fact that the small mestome bundles showed a distinct interruption of this sheath. Prof. Schwendener (*in litteris*) has kindly informed me that he considers it to be a true mestome sheath, even if it is broken in the smallest bundles, which, according to his very welcome criticism, is rather seldom. From this fact there seems to be a stronger reason for uniting *Uniola Palmeri* with the genus *Distichlis*, since both have typical mestome sheaths besides the other characters they have in common.

The stereome is quite strongly developed in *Leersia oryzoides*, and forms groups above and below all the mestome

² Die Mestomscheiden der Gramineenblaetter, p. 413.

³ BOTANICAL GAZETTE, August and October 1891.

bundles, situated in the lateral parts of the blade; the bundles of the carene form an exception, as seen in the figures 7 and 8: the large median nerve having no stereome on its hadrome-side. The same peculiarity is also found in the small bundles next the median (fig. 8). The three small mestome bundles, situated on the superior face of the carene (fig. 8) have merely stereome on their hadrome side, while the leptome shows only a small layer of stereome cells or none at all. One large isolated group of stereome is to be found in the outermost margin of the blade.

The mesophyll forms a dense tissue without any lacunes, and occupies a rather large part of the blade, as separate groups between the nerves. The mesophyll is in the carene restricted to the superior part of this, while a considerable layer of stereome covers the inferior face, the center part being occupied by a colorless parenchyma of considerable development.

U. S. Dep't of Agriculture, Washington, D. C.

EXPLANATION OF PLATE XXI.—Sections of the leaf of *Leersia oryzoides*.—Fig. 1. An epidermis cell of the inferior face of the blade, showing the roundish, wart-shaped expansions. $\times 400$.—Fig. 2. Hair from the inferior face. $\times 400$.—Fig. 3. Thorn-shaped expansion from the bulliform cells of the inferior face. $\times 400$.—Fig. 4.—A curved thorn-shaped expansion from the inferior face; longitudinal section. $\times 400$.—Fig. 5. The same seen from the front. $\times 400$.—Fig. 6.—The same, transverse section. $\times 400$.—Fig. 7. Transverse section of a part of the blade, including the carene. *J*, the inferior face; *BC*, the bulliform cells. The specimen from which this section is taken was collected near Washington, D. C. $\times 75$.—Fig. 8. Similar section, but from a specimen collected in Texas. $\times 75$.—Fig. 9. Transverse section of one of the largest mestome bundles. There is, besides, a chlorophyll bearing parenchyma sheath (*P*); a thick-walled mestome sheath (*MS.*), which surrounds the leptome and the hadrome. *S*, the stereome. *J*, the inferior face of the blade. $\times 320$.—Fig. 10. Transverse section of a small mestome bundle from the lateral part of the blade. Letters as above. The parenchyma sheath is colorless and thin-walled, like the mestome sheath. *SF.*, the superior face of the blade. $\times 400$.—Fig. 11. Transverse section of a small mestome bundle situated on the superior face of the carene. $\times 320$.—Fig. 12. A part of the leptome of the midrib, showing the sieve tubes (*ST.*) and the companion cells (*C*) in transverse section. $\times 400$.